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NOTES ON GEOGRAPHIC DISTRIBUTION

First records of *Mobula hypostoma* (Bancroft, 1831), Atlantic Pygmy Devil Ray, (Myliobatiformes, Mobulidae) and other devil rays in shallow waters of the Republic of the Congo, Gulf of Guinea (West Africa)

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Abstract. *Mobula hypostoma* (Bancroft, 1831), Atlantic Pygmy Devil Rays, were observed during megafauna surveys in the shallow coastal waters off the Republic of the Congo. These are the first records of this species in its natural habitat in Congolese waters, which may well offer an important habitat for these coastal batoids, but further research is needed. There is an urgent need for management measures to protect *M. hypostoma* throughout its African range, particularly in view of the recent increase in fishing activities within the region.

Key words. Conservation, distribution, elasmobranch, megafauna survey

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INTRODUCTION

Mobulids (family Mobulidae), comprising both manta rays and devil rays, are filter-feeding elasmobranchs distributed worldwide in tropical and subtropical waters, and extending slightly into temperate regions. They vary in size between approximately 1 m and 7 m in disc width (DW). The genus *Mobula* Rafinesque, 1810 includes nine species, four of which are circumglobal: *M. birostris* (Walbaum, 1792), *M. mobular* (Bonnaterre, 1788), *M. thurstoni* (Lloyd, 1908), and *M. tarapacana* (Philippi, 1892). Three other species of *Mobula* are confined to the Indo-Pacific waters: *M. alfredi* (Krefft, 1868), *M. kuhlii* (J.P. Müller & Henle, 1841), and *M. eregoodoo* (Cantor, 1849), and one species, *M. munkiana* (Notarbartolo di Sciara, 1987), to the Eastern Tropical Pacific. The distribution of *M. hypostoma* (Bancroft, 1831), Atlantic Pygmy Devil Ray, is limited to the tropical and warm-temperate Atlantic Ocean.

Until recently, two pygmy devil rays having distinct ranges were recognised in the tropical Atlantic: *M. hypostoma* (Bancroft, 1831) on the west side, and *M. rochebrunei* (Vaillant, 1879) along the African side. However, White et al. (2018) concluded that *M. rochebrunei* is a junior synonym of *M. hypostoma* on the basis of mitochondrial genome data. Accordingly, *M. hypostoma* is now called the Atlantic Pygmy Devil Ray and recognized as occurring on both sides of the tropical Atlantic Ocean. The conservation status of this species was most recently assessed by the International Union for the Conservation of Nature as Endangered (Marshall et al. 2022).

Devil rays are challenging to observe and study in their natural environment, and there are relatively few locations around the world where they are easily approached (e.g. Thorrold et al. 2014; Palacios et al. 2023). The devil rays are poorly documented in much of the eastern tropical Atlantic (ETA), which extends along the west coast of Africa from Mauritania to Angola and includes the Gulf of Guinea. Cadenat (1960) reviewed the genus in the waters of the northern ETA based on specimens caught in local fisheries. Since then, more information has been compiled, and the following species are known to occur off West Africa in addition to *M. hypostoma*: *M. birostris*, *M. thurstoni*, *M. tarapacana*, and *M. mobular* (Cadenat 1960; Amandé et al. 2010; Vasco-Rodrigues et al. 2016; Stevens et al. 2018).

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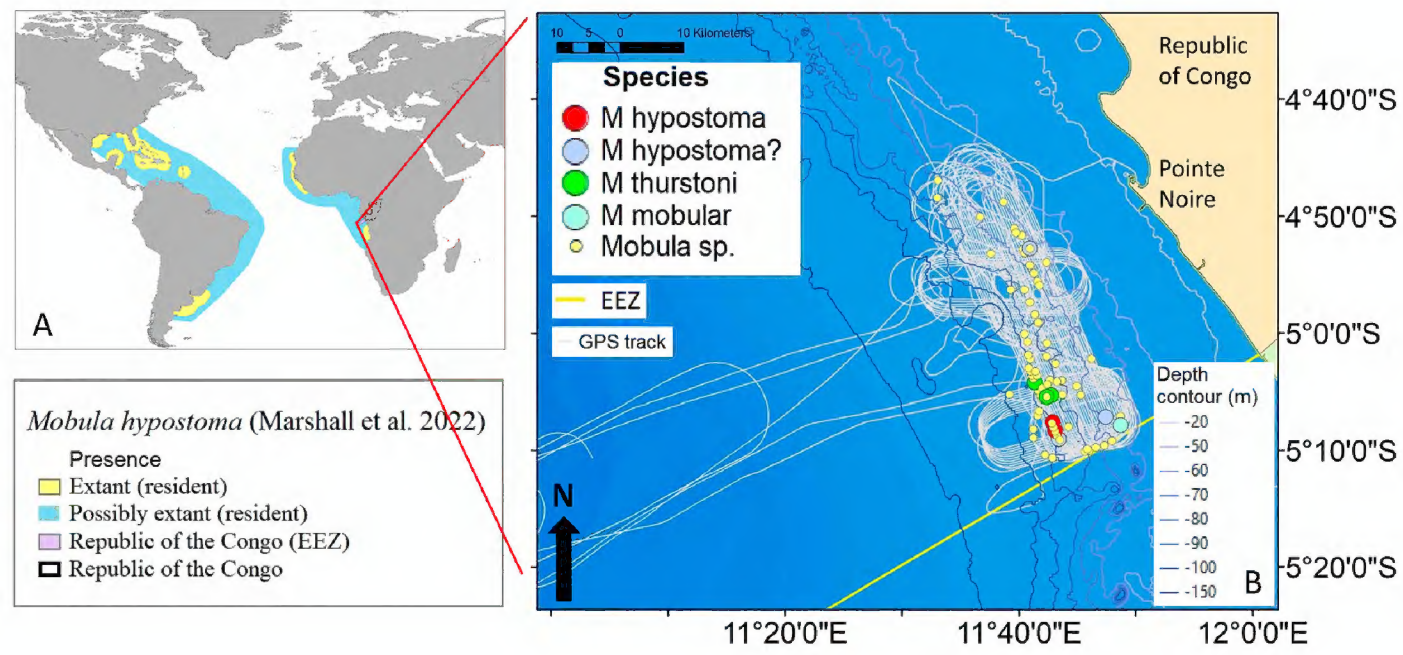


Figure 1. A. Global distribution of *Mobula hypostoma* showing extant (yellow) and possibly extant (blue) ranges and the location of the EEZ of the Republic of the Congo (pink) (modified from Marshall et al. 2022). **B.** Records of *M. hypostoma* and other devil rays in the Republic of the Congo. Red and violet symbols represent *M. hypostoma*, green symbols show the positions of *M. thurstoni*, and the light blue symbol shows the position of *M. mobular*. *Mobula* rays that could not be identified at the species level are represented by yellow symbols. The vessel track is shown (light grey line), and the southern EEZ border of the Republic of the Congo is also shown (yellow line).

The distribution of the East Atlantic population of *M. hypostoma* is poorly known, and the population is likely substantially depleted by overfishing (e.g. Ward-Paige et al. 2013; Doherty et al. 2023). The species has been confirmed for Angola, Cape Verde, The Gambia, Guinea, Guinea-Bissau, Mauritania, Sao Tome and Principe, Senegal, Sierra Leone, and Western Sahara (Marshall et al. 2022). However, its contemporary presence remains uncertain for many West African countries that fall within the assumed geographic range, including the Republic of the Congo (Fig. 1; Marshall et al. 2022). In particular, the species is now apparently extremely rare or altogether absent from a large portion of its northernmost range, from Western Sahara to Nigeria (R. Jabado pers. comm.), whereas it was considered common in Senegal in the 1960s (Cadenat 1960).

Here we report on several sightings of *M. hypostoma* off the Republic of the Congo, together with other devil ray species observed in coastal waters during a marine megafauna survey in August and September 2023.

METHODS

Dedicated marine megafauna observations were carried out within the waters of the Republic of the Congo aboard a geophysical survey vessel (13 August–14 September 2023). Survey coverage was determined by the design of the geophysical survey, which resulted in a series of parallel transects carried out in shallow waters (40–100 m) in the southern part of the Republic of the Congo's Exclusive Economic Zone (EEZ; Fig. 1). The research vessel *SW Empress* operated with a survey speed of approximately 7.4 km/h. During the survey, observational efforts were conducted from the bridge wings and foredeck (14 m above sea level). Observations were carried out during all daylight hours in 2-hour time intervals (0500–1700 h UTC). Sighting data included the time (UTC), position (from GPS), water depth, species, group size, and behavioural activity. Environmental observations were also collected, including wind speed and direction, swell height, visibility, and Beaufort sea state. When conditions allowed, marine fauna were photographed to confirm the species identification using a Canon DSLR camera (7D mark II) with a 70–200 mm f2.8 zoom lens and a 1.4 converter. A Garmin GPS receiver (Garmin GPSMAP 78sc) was used to log the ship's position every minute.

RESULTS

Mobula hypostoma (Bancroft 1831)

Figures 2, 3

New records. REPUBLIC OF THE CONGO • offshore in southern EEZ waters; 05°08′21.94″S, 011°43′04.98″E; 84.0 m depth; 20.IIX.2023; De Boer M obs. • same locality; 05°07′36.95″S, 011°42′53.64″W; 84.0 m depth, 20.IIX.2023; De Boer M obs.

One breaching devil ray (Individual 1) was sighted at a distance of 500 m from the vessel at 15:28 UTC. The breaching events occurred on two separate occasions probably involving the same animal. During the second breaching event, photographs were made of what was assumed to be the same individual. A second individual (Individual 2) was observed at 15:38 UTC swimming just below the surface exposing both pectoral fin tips.

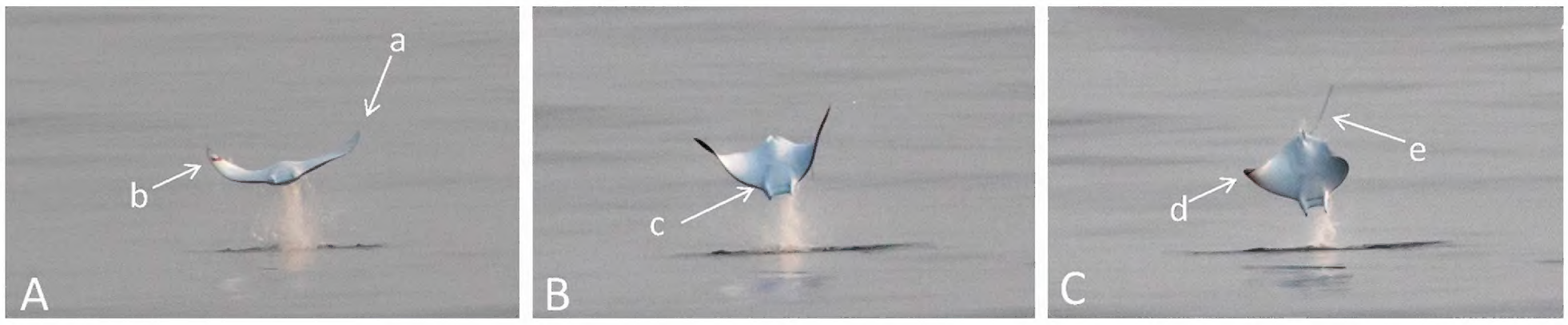
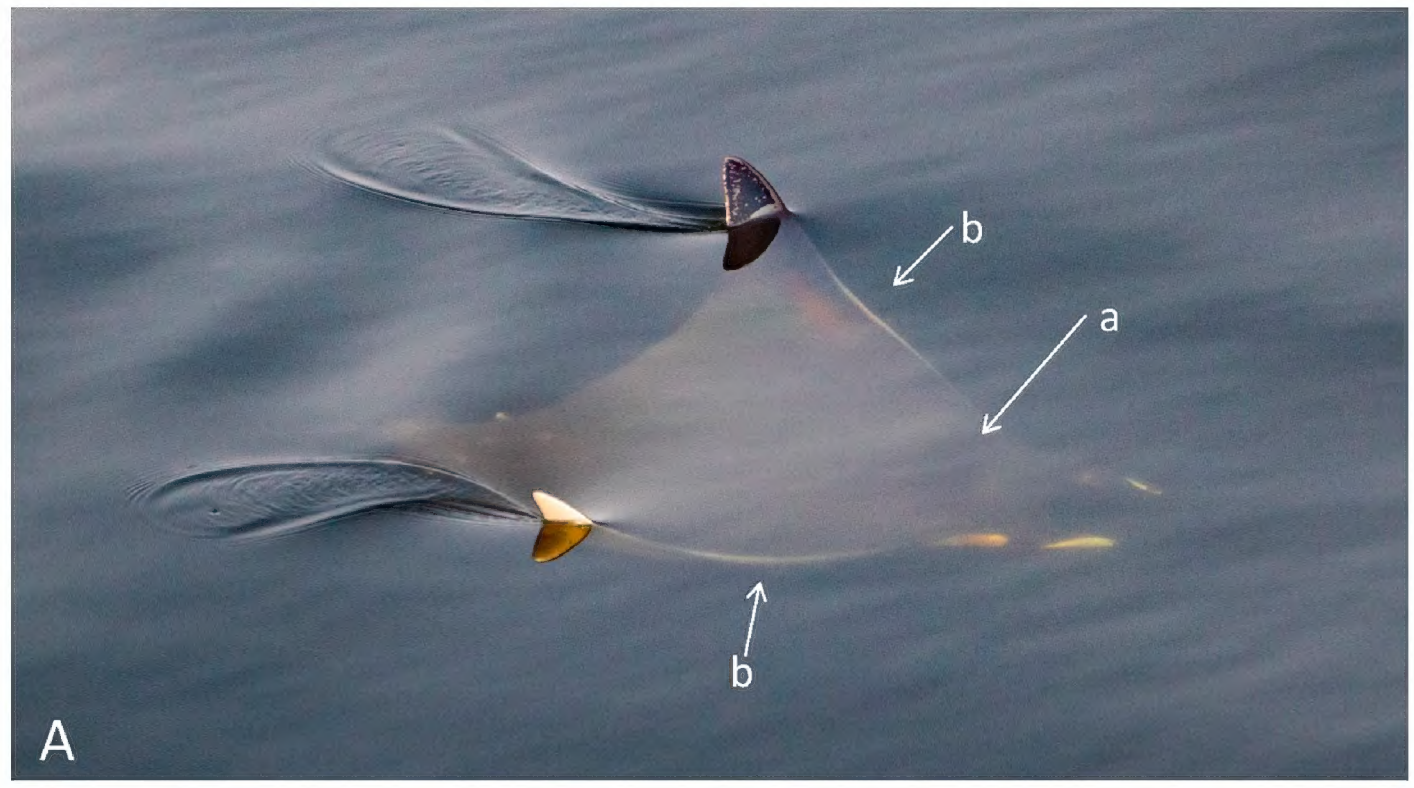


Figure 2. Photographic sequence of a breaching *Mobula hypostoma*, Individual 1. **A.** Short and pointed dorsal fin tips (see arrow a); note the evident scar on the left fin tip, possibly from a recent mating or predator wound (see arrow b). **B.** Some shading is evident extending ventrally onto the anterior of the first gill cover near the margin where pectoral fins join the body (see arrow c). **C.** The ray has a white ventral surface, tending to an increasingly darker grey/tan colouration towards the distal ends of the pectoral fins (see arrow d) and a relatively short tail (see arrow e). The disc width is only slightly greater than disc length. Photo credits: M. de Boer.



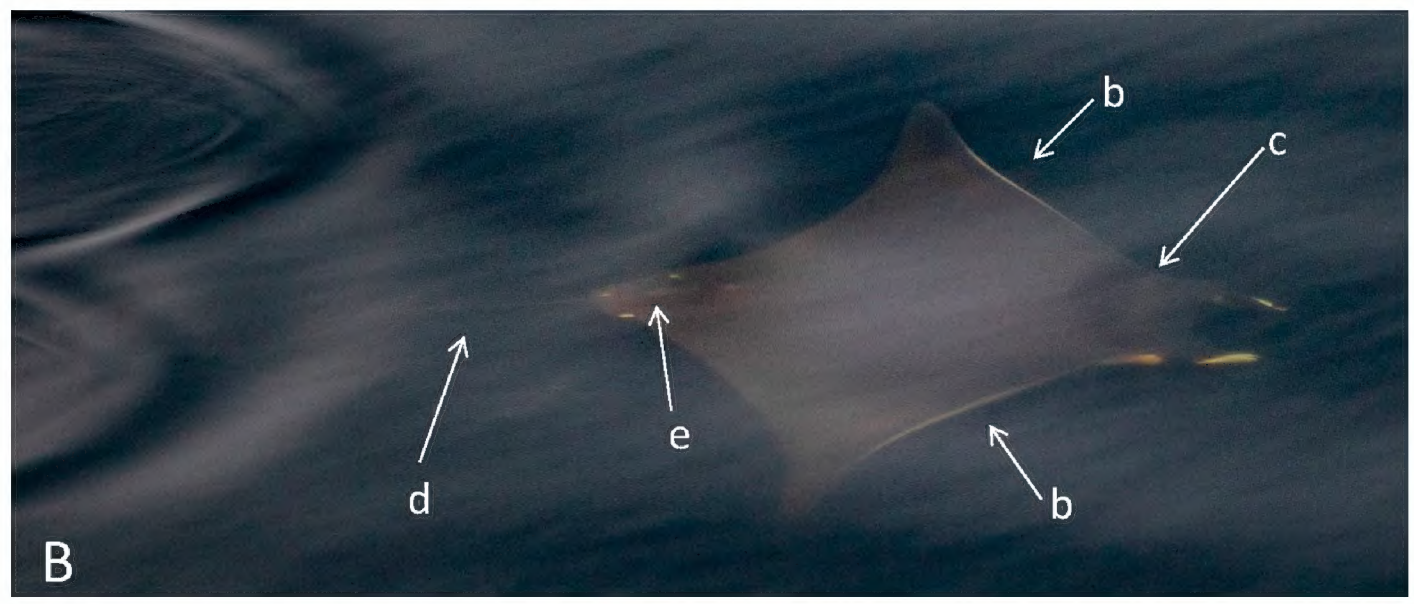


Figure 3. Photographic sequence of *Mobula hypostoma* swimming just below the surface, Individual 2. **A.** Exposing both pectoral fin tips, a dark "collar" is evident (see arrow a) and light grey stripes are visible running along the anterior dorsal margins of the pectoral fins (see arrows b). **B.** The dark "collar" is visible just behind the head with a lighter strip in front (see arrow c) sandwiched between the collar and a dark mouth strip. The tail appears to be shorter than the disc width (see arrow d) and the disc width is only slightly greater than disc length. The dorsal fin has a lighter grey area in the middle and the tip (see arrow e). Photo credits: M. de Boer.

Identification. The general body length (DW < 150 cm) and profile of Individual 1 were like the typical shape of a small devil ray (Figure 2). The photographs reveal that the pectoral fins had pointed, short tips. The ray had a white ventral surface, tending to an increasingly darker grey/tan colouration towards the distal ends of the pectoral fins. There was also some shading apparent, extending ventrally onto the anterior of the first gill cover near the margin where pectoral fins joined the body and also along the edge of the face. The tail appeared shorter than the disc width, and the disc width did not appear to be much greater than the disc length.

The photographs reveal that Individual 2 had the general profile and typical shape of a *M. hypostoma* (Figure 3). The ray had a brown dorsal surface and a darker "collar" just behind the head sandwiched between the collar and a dark mouth strip. Light-grey stripes were visible running along the anterior dorsal margins of the pectoral fins. The tail was shorter than the disc width, and the disc width did not appear to be much greater than the disc length. It was further evident that the dorsal fin had a lighter grey area in the middle and the tip. The fact that the disc width did not appear to be much greater than the disc length combined with the small size of the ray and some of the other features visible in the photographs, confirm that these individuals were *M. hypostoma* (Stevens et al. 2018).

An individual of *M. mobular*, Spinetail Devil Ray, was sighted on one occasion during the survey. This specimen was much larger (maximum DW 350 cm), its pectoral fins had a much greater aspect ratio (= length/width ratio), the ventral surface was entirely white, and the tail was very long (Stevens et al. 2018; Figure 4). Another devil ray which was recorded on several occasions during the survey was *M. thurstoni*, Bentfin Devil Ray, which is also larger (maximum DW 183 cm) than *M. hypostoma* and has pectoral fins with a distinct "double curvature" with dark ventral shading on the curve (Stevens et al. 2018; Figure 5).

Figure 4. Photographic sequence of two *Mobula thurstoni* (Lloyd, 1908), Bentfin Devil Ray, which are swimming just below the surface and probably engaged in reproductive behaviour. Pectoral fin tips have a distinct "double curvature" with dark shading on ventral side of the curve (see arrows). Photo credits: M. de Boer.

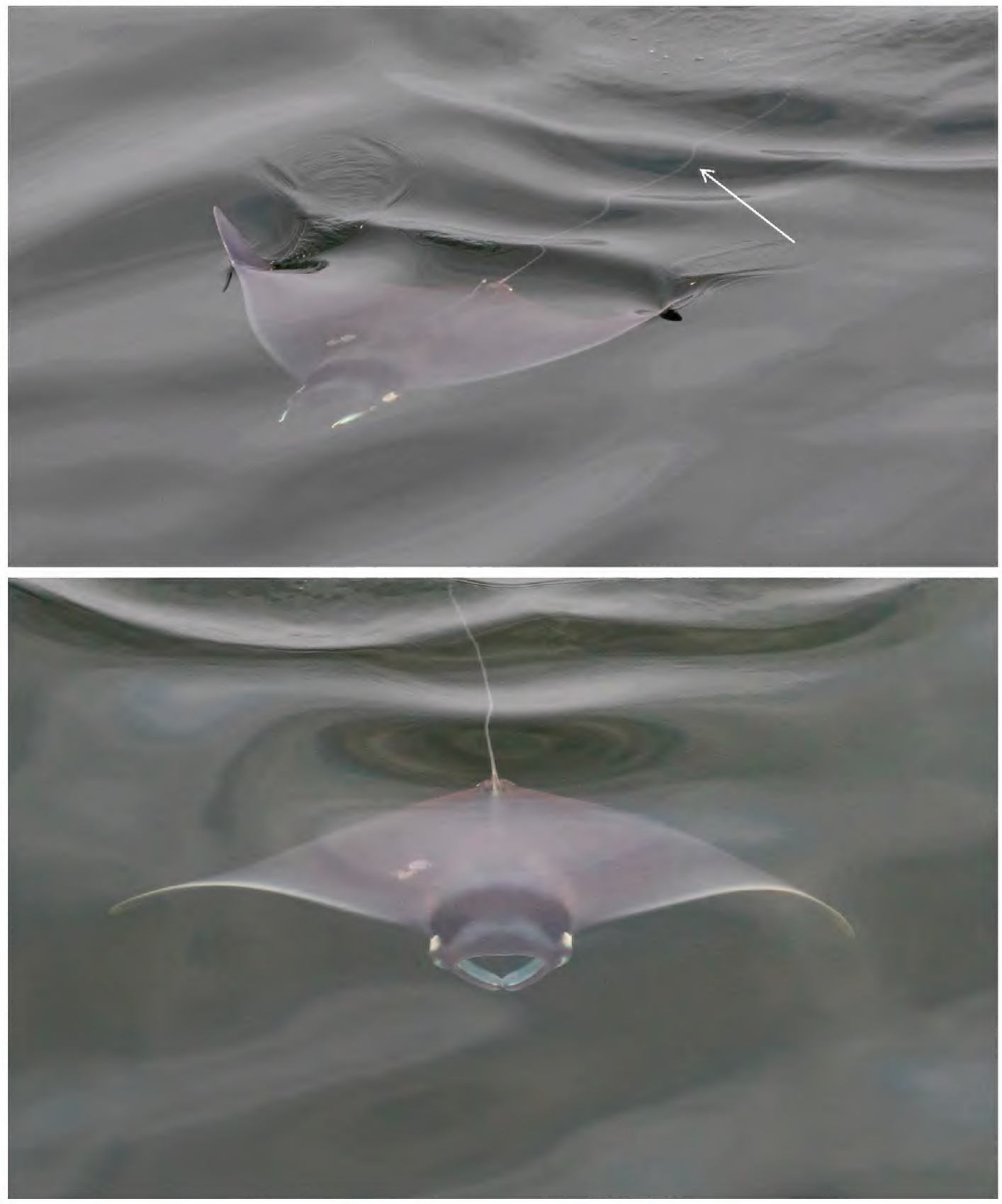


Figure 5. Photographic sequence of *Mobula mobular* (Bonnaterre, 1788), Spinetail Devil Ray, which is swimming just below the surface exposing pectoral fin tips and has a very long tail (see arrow). Photo credits: M. de Boer.

DISCUSSION

This note reports the first records of *Mobula hypostoma*, Atlantic Pygmy Devil Ray, in the shallow waters of the Republic of the Congo. During this survey, 122 sightings of *Mobula* species were recorded with a sighting rate of 2.28 sightings/hr when the vessel was operating within shallow waters (<100 m; survey effort: 278 h, 19 min). Three devil ray species were identified, but for the vast majority of sightings, it was not possible to obtain clear photographs to allow identification to species level (92.5%). On the afternoon of 20 August, a large aggregation of devil rays was recorded during a period of three hours in shallow waters (60–84 m). It was estimated that between 125 and 150 rays were present at the surface within a 0.5 × 0.5 km area, and this continued to be so for at least three hours, during which the vessel maintained its survey speed. Most of these rays were probably *M. hypostoma*, although some larger rays were also seen but not identified to species. *Mobula hypostoma* is known to occasionally travel in large schools, and the species is known to feed on zooplankton and small fish (Stevens et al. 2018). It is therefore of interest to note that these rays were observed in waters influenced by the Congo River plume. The waters were brown, and there were large amounts of floating plant debris and evidence of algal blooms was seen that afternoon and throughout the survey period.

Existing knowledge about devil rays within the ETA is limited (e.g. Blache et al. 1970; Notarbartolo di Sciara 1987; Castro et al. 2000; Weir et al. 2012; Stevens et al. 2018; Notarbartolo di Sciara et al. 2020) and mostly to older records from the waters in Senegal and Ivory Coast in the northern hemisphere (Cadenat 1960). *Mobula* records have previously been reported between Gabon and Angola (Weir et al. 2012). *Mobula thurstoni* was photographed in September 2005 in the Republic of the Congo (Pointe Noire), and *M. mobular* was photographed in August 2004 at the surface in deep offshore waters on the border of Angola/Democratic Republic of Congo (Weir et al. 2012). A recent study analysing artisanal fisheries highlighted that the Republic of the Congo is a hotspot for threatened sharks and rays (Doherty et al. 2023). Although the catches mainly involved endangered sharks, five species of *Mobula* were identified: these were mainly *M. thurstoni* and *M. mobular*, but they also included *M. hypostoma*, *M. tarapacana*, and *M. birostris* (Doherty et al. 2023). However, there was no information on the natural habitat of the captured species available without positional data to certify as to where the rays had been caught. Artisanal fisheries use "pirogue" fishing boats (open wooden canoes with an outboard engine), which generally operate inshore but can go further offshore (Metcalfe et al. 2016). In the present study, pirogue fishing canoes were observed in waters from 50 to >100 m deep. Pirogue fishing boats have indeed been reported to go further offshore in Congolese waters (82 km; Metcalfe et al. 2016) and into neighbouring waters (Portnews 2016). Small-scale fisheries within Congolese waters are under pressure from overexploitation, industrial and illegal trawl fisheries, and expanding offshore oil infrastructure (reducing the area where the pirogue fisheries can operate; Belhabib and Pauly 2015). As a result, the artisanal fishery in West Africa shifted its focus further afield and into shark fishing, as sharks are a cheap source of protein, which also provides an extra source of income from selling sought-after fins (Sall et al. 2021).

The shallow waters influenced by the Congo River plume may well offer suitable habitat for these devil rays, and *M. hypostoma* in particular. This is especially important considering the dearth of recent observations of the species across the northernmost portion of its range in the East Atlantic from Western Sahara to Nigeria, pointing to a likely status of severe depletion. This is probably caused by high fishing pressures which are a known threat to mobulids in many areas of the world, including West Africa (Couturier et al. 2012; Croll et al. 2015), where intensive fishing pressures continue, but *M. hypostoma* is no longer reported in the bycatch of the purse-seine fisheries or industrial trawl fisheries that operate there (Zeeberg et al. 2006; Amandè et al. 2010).

Given the heavy and unregulated fishing pressure which exists throughout the African range of *M. hypostoma*, together with this species' very low reproductive potential (e.g. Couturier et al. 2012), it is likely that populations in the northern part of its range have been heavily impacted and have been fished to near extinction. The Congolese government is currently planning the creation of three new marine protected areas (representing 12% of its EEZ; Doherty et al. 2023). The government is also revising current fisheries laws (Doherty et al. 2023), which will aid the protection of marine biodiversity and fisheries resources. However, alongside these actions and in view of the recent increase in fishing activities within the shallow waters off the Republic of the Congo and neighbouring countries (Gabon and Angola), there is an urgent need for management measures to protect *M. hypostoma* across its Eastern Atlantic range, but particularly in the southern portion, from Cameroon to Angola, where the species is still present.

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ADDITIONAL INFORMATION

Conflict of interest
The authors declare that no competing interests exist.

Ethical statement
No ethical statement is reported.

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Author contributions
Conceptualization: MDB. Data curation: MDB, AW. Methodology: MDB, AW. Validation: GN, MDB. Visualization: MDB. Writing – original draft: MDB, GN. Writing – review and editing: MDB, AW, GN.

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Data availability
All data that support the findings of this study are available in the main text.

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